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EFFECTS OF EARLY-CUTTING MANAGEMENT ON FORAGE YIELD AND QUALITY OF ALFALFA IN NORTHEAST KANSAS

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Alfalfa cutting management has been a topic of interest and concern in Kansas and other regions of the United States. Current recommendations for cutting schedules in Kansas are based on a combination of plant and crown-bud development. This is critical because Kansas has a highly variable climate, and alfalfa forage is harvested during both short- and long-day periods throughout the production season. Depending on the point of the cutting cycle and the existing environmental conditions, the "first regrowth at the crown" harvest indicator can occur at or prior to the 10%-bloom stage throughout the season.

The maturity stage at which alfalfa is initially harvested in the spring is important for several reasons. The new growth initiates from the crown buds, which depletes total nonstructural carbohydrate (TNC) root/crown reserves. Depending on the previous year's fall-cutting management and severity of winter and/or spring weather, an alfalfa field can be stressed early in the spring. Also, insect and

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disease damage to the alfalfa stand compounds the level of stress. These factors can greatly weaken and consequently reduce plant populations depending on management of the first cutting. If the stand is injured, forage yield and quality will decline. Finally, timeliness of the first cut will ultimately determine the total number of seasonal harvests and subsequent tonnage and quality possible for a growing season. We investigated the impact of harvesting first-cutting alfalfa at various maturity stages on forage yield and quality.

Procedure

This study was established in a producer's field near Keats, in northeast Kansas, with a 5-year-old stand of `Kansas Common' alfalfa grown under rain-fed conditions on a Reading silt loam. The study began in early spring 1990 and concluded after the first killing freeze in fall 1991. Identical first-cutting treatments were repeated in each year. The experimental design was a randomized complete block with four replications.

Eight first-cutting treatments (trts) were initially cut at the following maturity stages: 1) vegetative, 2) early-bud, 3) late-bud, 4) first-regrowth, 5) 25%-bloom, 6) 50%-bloom, 7) full-bloom, and 8) green-seedpod.

The initial cycle of trts took approximately 8 weeks to complete. Subsequent cuttings were harvested when regrowth was observed at the crown or at the 10%-bloom stage.

Plots were 5 x 22.5 ft. Average plant height in each plot was recorded prior to harvesting. Plots were cut with a 3 ft. sickle-bar mower at a $2^1/_2$-inch stubble height.

Forage yields were estimated by weighing the fresh forage from the entire plot area and converting to lbs. per acre dry weight. A randomly hand-picked subsample of approximately 1 lb. was obtained from each plot, oven dried to a constant weight, and used for both determination of dry matter (DM) content and quality analysis.

Dried samples were prepared for Near Infrared Reflectance Spectroscopic (NIRS) analysis by grinding through 1-mm screens in a Wiley mill followed by a Udy mill. NIRS analysis provided data for percent crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) on a 100% DM basis. ADF content was used to calculate percent digestible dry matter (DDM), and NDF content was used to calculate percent dry matter intake (DMI). In addition, the latter two calculations were used to calculate percent relative feed value (RFV). Total crude protein (TCP) was calculated by multiplying the forage yield times the CP. For the year-end totals, the TCP figure was yield weighted for the entire season of production.

Results

The first-cutting yields in 1990 (Table 1) increased as maturity advanced from trts 1 through 8. In contrast, most of the quality parameters (i.e., DDM, DMI, RFV, CP) declined. Total crude protein (for the first cutting only) was greater for trts 2 through 4 and 8 than for trts 1 and 7. Treatment 8 had higher TCP levels because the regrowth of what would have been the second cutting was cut with the initial harvest. However, this extremely late cutting (8 weeks after the first trt) tended to be low in quality and reduced the number of seasonal harvest opportunities.

Total seasonal yield data were collected to study the impact of first-cutting management on subsequent cuttings. The 1990 total forage yields for all trts varied less than $^1/_2$ ton, with the exception of trt 7, which had the lowest yield. The "second-cutting" crown regrowth under trt 7 was approximately 6- to 8-inches tall, indicating that root reserves were at a critically low level when the trt was initiated. This observation along with the detrimental effects of self-shading help explain the low seasonal yields for this trt.

Total seasonal forage quality data for 1990 indicated advantages for initially harvesting alfalfa at trt 4. Treatment 7 was lower in DDM than trts 1 through 5. There was a significant advantage in DMI and RFV for trt 4 compared to trts 1 and 2 and trts 6 through 8. The TCP was higher for trt 1 than all other trts, except trts 3 and 4.

In 1991, the study was continued on the same plots to investigate the effects of early-cutting management in the subsequent year. The first-cutting yield (Table 2) of trt 4 was higher than those of earlier trts; however, it was lower than those of the remaining trts. Treatment 1 was lower in yield, DDM, DMI, and RFV than trts 2 and 3.

In general, the quality parameters, excluding TCP, declined with advancing maturity after trt 2. The TCP (for the first cutting only) in 1991 was lowest for trt 1. Treatments 2 and 3 were lower in TCP than the balance of the trts. These results for lbs. of CP per acre for the early-cut trts are clearly paralleled by the differences in yield.

Total alfalfa yields for the 1991 season were higher for trts 3 through 6 and 8 than for trt 1. In addition, trts 5 and 6 were higher-yielding than trt 7.

Total seasonal forage quality data for 1991 indicated that, with the exception of trt 6, the first four trts were higher in DDM than later-cut trts. Treatment 1 was lower in DMI than trts 2 through 4. A decline in RFV occurred with advancing maturity after trt 2. The TCP for the 1991 season was higher for trts 3 through 6 than for trt 1.

Table 1. Effect of maturity stage on first-cutting alfalfa yields and quality in 1990.

Year 1st-Cutting Mat. Stage	HT1	Yields2	DDM3	DMI4	RFV5	CP6	TCP7
			Quality Factors				
(treatment)	in.	lbs./a	- - - - - - - - - - percent			- - - - - - - -	lbs/a
Vegetative (1)	16.0	2,395	63.7	3.10	152.4	26.0	624
Early-bud (2)	19.7	3,072	61.2	2.82	133.9	23.4	719
Late-bud (3)	21.5	3,509	60.7	2.80	131.8	21.6	758
First-regrowth[8] (4)	24.7	3,729	59.0	2.57	117.2	20.0	749
25%-bloom (5)	27.0	4,160	57.5	2.47	110.7	16.8	700
50%-bloom (6)	29.5	4,139	56.5	2.42	107.1	15.5	643
Full-bloom[9] (7)	31.0	4,110	56.0	2.37	102.9	14.3	589
Green-seedpod (8)	31.2	5,186	55.0	2.30	97.4	14.2	739
LSD (P≤.05)	1.0	335	1.5	0.14	8.8	2.0	95
Year 1 Totals[10]							
Vegetative (1)		11,254	58.4	2.40	110.2		2,000
Early-bud (2)		10,817	57.7	2.39	108.5		1,794
Late-bud (3)		11,495	58.3	2.49	113.3		1,898
First-regrowth (4)		10,789	58.6	2.54	115.5		1,938
25%-bloom (5)		10,907	57.6	2.53	114.1		1,759
50%-bloom (6)		10,705	57.4	2.46	110.0		1,732
Full-bloom (7)		8,586	56.7	2.36	104.0		1,340
Green-seedpod (8)		10,508	56.9	2.42	106.7		1,701
LSD (P≤.05)		600	0.9	0.08	5.0		179

1 Average height of five measures
2 Estimated from a 5’ x 22.5’ plot size; 100% dry matter basis
3 Digestible Dry Matter (% of dry matter) = 88.9-[0.779 x %Acid Detergent Fiber (ADF)]. Totals are yield weighted.
4 Dry matter Intake (% of Body Weight (BW)]=120/%Neutral Detergent Fiber (NDF). Totals are yield weighted.
5 %Relative Feed Value=(DDM x DMI)/1.29. Totals are yield weighted.
6 %Crude Protein
7 Total Crude Protein; forage yield x CP of raw data. Totals are yield weighted.
8 In 1990, first regrowth at the crown occurred at one-tenth bloom.
9 Critical 6- to 8-inch regrowth present
10 Vegetative stage was cut five times, early-bud through 50%-bloom stages were cut four times, and full-bloom and green-seedpod stages were cut three times during 1990.

Table 2. Effect of maturity stage on first-cutting alfalfa yields and quality in 1991.

Year 2 1st-Cutting Mat. Stage	HT1	Yields2	DDM3	DMI4	RFV5	CP6	TCP7
			Quality Factors				
(treatment)	in.	lbs./a	- - - - - - - - percent			- - - - - - - - - -	lbs/a
Vegetative (1)	8.5	1,414	57.3	2.52	112.9	20.1	289
Early-bud (2)	13.0	2,277	60.6	2.95	139.3	20.8	473
Late-bud (3)	16.2	2,295	61.2	2.97	140.3	20.8	479
First-regrowth[8](4)	22.2	3,563	58.2	2.60	118.1	18.7	670
25%-bloom (5)	24.5	4,213	55.9	2.40	104.1	16.9	714
50%-bloom (6)	29.2	4,815	56.5	2.45	107.8	15.2	735
Full-bloom[9](7)	32.5	4,272	54.8	2.35	99.2	14.8	633
Green-seedpod (8)	31.2	4,944	53.7	2.27	95.1	12.9	640
LSD (P≤.05)	1.5	558	1.6	0.17	10.2	1.9	134
Year 2 Totals[10]							
Vegetative (1)		8,933	58.6	2.44	111.4		1,554
Early-bud (2)		9,893	59.1	2.59	119.9		1,813
Late-bud (3)		11,064	58.4	2.56	115.7		1,881
First-regrowth (4)		10,879	58.3	2.52	114.5		1,869
25%-bloom (5)		11,447	57.4	2.49	111.6		1,922
50%-bloom (6)		11,680	57.8	2.49	112.0		1,906
Full-bloom (7)		9,824	57.1	2.50	110.7		1,638
Green-seedpod (8)		11,070	56.6	2.47	109.5		1,739
LSD (P≤.05)		1600	0.9	0.08	4.7		302

1 Average height of five measures
2 Estimated from a 5' x 22.5' plot size; 100% dry matter basis
3 Digestible Dry Matter (% of dry matter) = 88.9-[0.779 X %Acid Detergent Fiber (ADF)]. Totals are yield weighted.
4 Dry matter Intake (% of Body Weight (BW)]=120/%Neutral Detergent Fiber (NDF). Totals are yield weighted.
5 %Relative Feed Value=(DDM x DMI)/1.29. Totals are yield weighted.
6 %Crude Protein
7 Total Crude Protein; forage yield x CP of raw data. Totals are yield weighted.
8 In 1991, first regrowth at the crown occurred at one-tenth bloom.
9 Critical 6- to 8-inch regrowth present
10 Vegetative through late-bud stages were cut five times, and the remaining maturity stages were cut four times in 1991.

Summary

Short-term yield advantages occurred for first cutting at the green-seedpod stage (trt 8), and short-term quality advantages occurred for first cutting at the vegetative stage (trt 1). These advantages became minimal or nonexistent when the total seasonal production was considered. The first-regrowth stage (trt 4) appears to be the compromise to obtain high alfalfa yields and quality.

Second-year data showed the impact of physiological stress caused by early-harvest management. First cutting at the vegetative stage gave no short-term superiority in quality and showed a severe yield depression. Likewise, second-year yields for the early-bud stage (trt 2) were relatively low. First cutting at the green-seedpod stage in year 2 showed similar, yet less extreme, trends than in year 1. For 2 consecutive years, first cutting at the full-bloom stage (i.e., 6-8" second regrowth; trt 7) showed season-long declines in yield and quality.

Conclusions

Two years of results gathered from an established stand of `Kansas Common' indicate that the window for harvesting first-cutting alfalfa should be between late-bud (i.e., just prior to regrowth; trt 3) and 50%-bloom stage (i.e., less than 6" regrowth present; trt 6) in order to maintain high production levels over multiple years. Many of the responses to early-harvest management are directly related to changes in stand persistence. These changes should be considered in the overall management scheme, because they will ultimately determine longevity of the alfalfa stand.

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